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EFFECT OF HUMIC AND FULVIC ACIDS WITH SOME NUTRIENTS AT DIFFRENET TIME OF APPLICATION ON YIELD AND FRUITS QUALITY OF ANNA APPLE TREES

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ABSTRACT

The present investigation was undertaken during the selected two successive seasons of 2012 and 2013 on 12 years old Anna apple trees (*Malus domestica*, Borkh) budded on Shobra khan apple rootstocks. The selected trees were planted in a private orchard in Tanta, Gharbia Governorate, in clay soil and spaced at 3 x 4 meters apart. The trees were trained as open-vase form, irrigated by Nile water using surface irrigation (basing irrigation) system. The selected trees received the same horticultural practices and fertilization regime. The experiment was conducted on 60 apple trees Anna cv . in both seasons, ten treatments were carried out, each treatment replicated three times considering each two trees as a replicate using a split plot design , Humic and fulvic acids were added at 4 liter/fed. and mix with calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) as foliar spray at five development stages (at bud burst , fruit set, at the beginning of false coloring , at the end of false coloring and at the beginning of true coloring.

Sprayed trees with fulvic acid at 4 liter/fad. and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) at bud burst (T6) significantly increased both leaf surface area and shoot length in both seasons. While T7 sprayed trees with fulvic acid at 4 liter/fed. and mix., calcium , zinc and boron after fruit set recorded the highest values of fruit number/tree, fruit weight and fruit volume, soluble solid content, soluble solid content /acid ratio and total sugars and decreased specific gravity in fruits in both seasons . fruit height and diameter were increased with sprayed trees with humic acid at 4 liter/fed and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) at the beginning of false coloring) during the two seasons of study . The trees sprayed with humic acid at 4 liter/fad. and mixture of calcium nitrate (0.4 %), zinc sulphate (250 ppm) and borax (20 ppm) at beginning of true coloring and the end of false coloring on Apple fruits (T4 and T5) gave significant increase of fruit firmness in both seasons as compared to other tested treatments

Keywords: Apple, humic, fulvic acids, calcium, zinc and boron, yield, firmness and time of application.

INTRODUCTION

Apple fruit is well characterized for their taste, flavor and dietary values. It is one of the genera of pome fruit trees of the temperate zones belonging to the Rosaceae family and is one of the most important garden crops and due to its high adaptability and it is one of the most extensively fruit trees cultivated in temperate zones. Health and superior quality of fruit as one of the most crucial organs of the trees is in direct relation with health of humans. The total acreage of apple in Egypt reached about 52862 fed. during 2012 season and producing about 541239 tons with average of 10.238 tons/feddan (FAOSTAT).

Humic substances are extremely complex heterogenous mixtures, and researchers have not been able to isolate pure humic substances (MacCarthy *et al*., 1990). Reactions between metals, minerals, and humic substances can take place via one or more of the following mechanisms: (1) formation of water soluble simple metal complexes; (2) formation of water-soluble mixed ligand complexes; (3) sorption on and desorption from water-insoluble humic acids and metal-humate complexes; (4) dissolution of minerals; (5) adsorption on external mineral surfaces; (6) adsorption in clay interlayers (Schnitzer, 1986). Fulvic acid is water soluble and humin is water insoluble under all pH conditions, while humic acid is water soluble when pH is about 2 (Malcolm, 1990). Metal-humic acid and metal-fulvic acid complexes may play an important role in the availability of metals to roots (Schnitzer, 1990).

Ferrara and Brunetti (2010) studied the effect of humic acid at a concentration of 100 mg /L in four different times: pre-bloom, full-bloom, fruit set and veraison on table grape. They found that humic acid applied at full-bloom induced a significant increase of berry size (width and weight).

El-Kosary *et al*. (2011 found that spraying 0.5 g/l Tradecorp AZll (complex EDTA, that contained with 5% Fe, 2.48% Zn, 3.5% Mn, 1% Cu, 0.65% and 0.3% Mo) + soil supplementation by 40 cm/tree Helpstar (containing Tradecorp AZll 12% humic acid, 3% fulvic acid and 16% organic material) significantly increased fruit weight, height, width, volume, yield per tree, fruit firmness, TSS and total sugar in mango fruits. Elatar (2012) found that application of fulvic acid at 83.33 ml/palm tree + treated palm tree with micro-organisms at 83.33 ml/ palm plus microelements at (3.12 gm from $FeSO_4.7H_2O$+ 1.56 gm from $ZnSO_4.7H_2O$ + 1.56 gm from $MnSo_4.H_2o$)/ as soil application / palm recorded the highest values of fruit weight, length, diameter, size, flesh weight and yield/palm. Hagagg, *et al.* (2013) found that on Aggizi" olive, the highest fruit size (volume), weight, shape index (length\ diameter) pulp\pit ratio and total yield were recorded in trees sprayed with humic acid at 0.5 % followed by trees sprayed with 0.25% or 0.125% humic acid.

Deficiencies of various micronutrients such as Ca, Zn and B are related to soil types, plants and even to various cultivars. Most micronutrients are readily fixed in soil having alkaline pH. Plant roots are unable to absorb these nutrients adequately from the dry topsoil (Graham *et al.*, 1992). Although, micronutrient elements are needed in relatively very small quantities for adequate plant growth and production, their deficiency may cause great disturbance in the physiological and metabolic processes involved in the plant (Babaeian, *et al.*, 2011). Thus, the application of micronutrients fertilizer in the cultivation zone may not be meeting the crop requirement for root growth and nutrient use. The alternative approach is to apply these micronutrients as foliar sprays.

Khalifa *et al*.(2009) found that fruit length, total sugars and total anthothyanin. increased with boric acid at 0.1 % and 0.4 % calcium chloride , fruit diameter increased with boric acid at 0.1 % and 0.2 % calcium chloride and height/ diameter increased with boric acid at 0.1 % and 0.1 % calcium chloride, TSS increased with boric acid at 0.05 % and 0.4 % calcium

chloride, acidity increased with boric acid at 0.025 % and 0.1 % calcium chloride in Anna apple fruit. Asgharzade and Babaeian (2012) showed that on apple use of micronutrient and calcium borate in foliar application method had significant effect on fruit firmness, total soluble solids, but maximum amount of fruit acidity was obtained in control treatment . Among all measured characters high amount fruit firmness, total soluble solids and fruit concentration of B and Ca was recorded in calcium borate treatment. Balesini, *et al*. (2013) studied the effect of different nutrient factors on fruit set and fruit quantity of apple trees , an experiment was conducted with 8 treatments including Thiofer, Ticaminmax, Ticaminmax + Oligogreen , Ticaminmax + B(Boran) + Zn(HAS Zn) 25% Fertilizer, B(Boran) + Zn(Has Zn) 25% HAS green Italy, B(Boron) + Zn(Has Zn) 25%+Thiofer,B(Boron) + Zn(Has Zn) 25% Ticaminmax and control(water) in the buds swell stage. They found that treated foliar application with Thiofer + Br + Zn had greatest effect in yield compared to unsprayed trees. Yadav *et al.* (2013) reported that foliar spraying of peach trees with 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ was the promising treatment for improvement of fruit growth, fruit height, fruit diameter, fruit volume and fruit firmness. Asaad (2014) showed that spraying with 15 ppm CPPU accompanied by 10gm Fe + 7gm Mn + 10.5gm Zn/20L water recorded the highest values of vegetative growth parameters (shoot diameter, shoot length, and leaf surface area of Anna Apple trees) as compared with unsprayed trees

The scope of the present investigation is to detect the effectiveness of the time of application of humic and fulvic acids and some nutrients in enhancing the vegetative growth, productivity, fruit quality of Anna apple.

MATERIALS AND METHODS

The present investigation was undertaken during the selected two successive seasons of 2012 and 2013 on 12 years old Anna apple trees (*Malus domestica*, Borkh) budded on Shobra khan apple rootstocks. The selected trees were planted in a private orchard in Tanta, Gharbia Governorate, in clay soil and spaced at 3 x 4 meters apart. The trees were trained as open-vase form, irrigated by Nile water using surface irrigation (basing irrigation) system. The selected trees received the same horticultural practices and fertilization regime.

The experiment was conducted on 60 apple trees Anna cv . in both seasons, ten treatments were carried out, each treatment replicated three times considering each two trees as a replicate using a split plot design , the treatments were as follow

1. Foliar spray with humic acid, calcium, zinc and boron at bud burst
2. Foliar spray with humic acid, calcium, zinc and boron after complete fruit set
3. Foliar spray with humic acid, calcium, zinc and boron at the beginning of false coloring
4. Foliar spray with humic acid, calcium, zinc and boron at the end of false coloring

5. Foliar spray with humic acid, calcium, zinc and boron at the beginning of true coloring
6. Foliar spray with fulvic acid, calcium, zinc and boron at bud burst
7. Foliar spray with fulvic acid, calcium, zinc and boron after complete fruit set
8. Foliar spray with fulvic acid, calcium, zinc and boron at the beginning of false coloring
9. Foliar spray with fulvic acid, calcium, zinc and boron at the end of false coloring
10. Foliar spray with fulvic acid, calcium, zinc and boron at the beginning of true coloring

Humic and fulvic acids extricated from compost tea were added at 4 liter/fed. mix with calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm).

Soil analysis was carried out before applied experimental treatments in the first season, are shown in Table 1.

Table 1. The chemical and physical properties of the orchard soil

Characters	Depth of soil (cm)		
	0-30	**30-60**	**60-90**
pH 1: 2.5	8.4	8.2	8.4
E.C.(mmhose/cm)	0.6	0.9	0.4
Na^{+} (meq /L)	2.9	3.5	2.9
Mg^{++} (meq/L)	1.9	2.05	0.9
Ca^{+2} (meq/L)	0.85	3.5	1.25
So_4^{-2} (meq/L)	1.68	4.8	1.57
CL^{-} (meq/L)	3.05	3.75	2.25
Hcl^{-} (meq/L)	0.5	0.7	0.3
N (ppm)	70	90	70
P (ppm)	12.3	13.86	10.78
K (ppm)	525	712	525
Fe (ppm)	9.54	6.18	7.84
Cu (ppm)	3.60	4.02	3.26
Zn (ppm)	11.52	13.72	26.76
Mn (ppm)	3.98	18.83	5.22

The other cultivated practices for apple production were used according to the instruction laid down by the Ministry of Agriculture, Egypt.

Data recorded

Four main branches from different directions per each tree were labeled to determine all the required measurements, which were: -

Vegetative growth measurements

Leaf surface area (cm^2): A sample of twenty five mature leaves (fully expanded and healthy) were collected randomly at the mid June of each seasons in order to calculated leaf surface area (cm^2) as described by Koller, (1972). Shoots length (cm) were measured at the end of July in each growing season, using a roller, and the mean was recorded.

Yield and fruit quality: Number of fruits per tree and yield (kg/ tree and per feddan) were recorded at harvesting time (at first of June). Samples consisting of twenty fruits were randomly taken from each replicate for the following; average fruit weight (g), fruit height (cm), fruit diameter (cm), fruit

volume (cm^3), firmness (lb/in^2), total sugars, soluble solids content % (SSC), total acidity (%) according to A.O.A.C. (1990) and SSC/acid ratio.

The obtained data were subjected to statistical analysis of variance according to the method described by Snedecor and Cochran (1980), and the New LSD method at 5 % level was used to compare between means (Waller and Duncan 1969).

RESULTS AND DISCUSSION

1. Leaf surface area and shoot length

Data presented in Table 2 showed the interaction effect of foliar application of humic and fulvic acids and some nutrient elements such as calcium, zinc and boron at bud burst, after complete fruit set, beginning, end of false coloring and beginning of true coloring of apple fruit on leaf surface area and shoot length of apple trees during 2012 and 2013 seasons, where the trees sprayed with fulvic acid at 4 liter/fad. and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) at bud burst as time of application (T6) significantly increased both of leaf surface area and shoot length (38.91 and 38.28 cm^2) and (52.00 and 53.33 cm) in the first and second seasons, respectively, followed by the trees sprayed with humic acid at 4 liter/fad. and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) at bud burst (T1). Also foliar spray with fulvic acid at 4 liter/fad. and mixture of calcium nitrate(0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) after fruit set (T7) in the 1^{st} season came in third order on leaf surface area and shoot length during two seasons of the study comparing with another tested treatments.

Finally, the trees sprayed with fulvic or humic acids with studied nutrient elements at early stages of fruit formation and coloring gave the best results on leaf surface area and shoot length of apple trees comparing with other treatments at other different time of applications.

Fulvic acid is water soluble and humin is water insoluble under all pH conditions, while humic acid is water soluble when pH is about 2 . Metal-humic acid and metal-fulvic acid complexes may play an important role in the availability of metals to roots and then increased shoot length and leaf surface area (Malcolm, 1990).

Plant growth is influenced indirectly and directly by humic and fulvic substances. The indirect effects, are those factors which provide energy for the beneficial organisms within the soil, influence the soil's water holding capacity, influence the soil's structure, release of plant nutrients from soft minerals, increased availability of trace minerals, and in general improved soil fertility. The direct effects include those changes in plant metabolism that occur following the uptake of organic macromolecules, such as humic acids, fulvic acids. Once these compounds enter plant cells, several biochemical changes occur in membranes and various cytoplasmic components of plant cells and then increase of root growth is generally more apparent than that of the shoot (Vaughan and Malcom, 1985).

Table (2): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on leaf surface area and shoot length of apple trees during 2012 and 2013 seasons.

Characters / Treatments	Leaf surface area (cm^2)		Shoot length (cm)	
	2012 season	2013 season	2012 season	2013 season
T1	37.04	38.03	50.00	51.00
T2	33.64	33.52	48.66	49.00
T3	31.38	31.70	47.00	47.33
T4	30.44	29.79	49.00	48.66
T5	33.01	32.73	47.00	47.66
T6	38.91	38.28	52.00	53.33
T7	38.21	35.21	50.00	50.33
T8	31.97	33.68	49.00	49.00
T9	29.04	33.12	47.00	45.33
T10	28.74	33.80	46.00	47.00
New LSD at 5% level	1.64	2.16	1.09	0.72

The obtained results are confirmed with those reported by Somaa (2007) and Zhang *et al*. (2013) on apple tree and Mayi *et al.* (2014) on olive transplants. They showed that application of humic or fulvic acids as foliar spray gave the best results for increasing shoot length and leaf area/ plant.

In this connection, Al-Imam and Al-Brifkany (2010), Balesini, *et al*. (2013) and Asaad (2014) on "Anna" apple trees. El-Badawy (2013) on Canino apricot trees. They showed that spraying trees with mixture of some nutrients, especially microelements recorded the best values of vegetative growth parameters (shoot diameter, shoot length, and leaf surface area) as compared with unsprayed trees.

2. Fruit number/ tree, yield/ tree and per feddan

Data in Table (3) revealed that, application of fulvic acid with mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) at fruit set (T8), (T7) (T3) and (T2) had markedly significant effect on fruit number/ tree, both yield /tree and fad. than other treatments. Moreover, data in Table (3) revealed that, treated Apple trees with fulvic and humic acids with mixture of calcium, zinc and boron at different stages had significant effect on number of fruit/ tree, yield/tree and yield per fad. than control treatment in both seasons.

Application of fulvic acid and mixture with calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20 ppm) at fruit set (T7), (T6), (T2) and (T1) had markedly significant effect on number of fruits/ tree both yield /tree and fad. than other treatments in both seasons. Moreover, T7 recorded the highest significant values of fruit number,yield/tree and yield/feddan (297.3 - 298.9), (52.63 -54.96 kg/tree) and (17.52-18.30 ton/fed) in the first and second seasons, respectively.

Humic acid is a commercial product contains many elements which increasing the availability of nutrient elements and consequently affected plant growth and yield (Hartwigson and Evans, 2000).

The obtained data are in accordance with those stated by Fallahi *et al.* (2006), Somaa (2007) and Zhang *et al.* (2013) on apple. They found that addition of humic or fulvic acids increased fruit number and yield/ tree and per feddan.Moreover, application of micronutrients significantly increase the number of fruits per tree and yield of the tree this effect might be due to the beneficial roles of boron in pollination (Lee and Kim, 1991) and zinc in growth promoting substances (Shivanandam *et al.,* 2007).

In this regard, Abd-Ella and El-Sisi (2006) , Mohammad *et al.* (2008) Khalifa *et al* .(2009) Asgharzade and Babaeian (2012) Balesini, *et al*. (2013) and Asaad (2014) on apple, El-Kosary *et al*. (2011) on mango, El-Badawy, (2013) on apricot trees. They found that spraying trees with individual or mixture of Zn, Mn and B recorded the maximum number of fruits/ tree and total yield.

Data also revealed that treatment of fulvic acid with studied micronutrients sprayed at bud burst came to the second rank in this concern.

In general, data obtained clearly indicated that delaying spraying time after fruit set stage led to a decrease in both fruit number and yield of Anna apple trees.

Table(3): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on yield and its components of apple trees during 2012 and 2013 seasons.

Treatments	Fruit number /tree		Yield/ tree (kg)		Yield (ton/fed.)	
	2012 Season	2013 Season	2012 Season	2013 Season	2012 Season	2013 Season
T1	252.0	266.6	42.00	43.29	13.986	14.415
T2	253.6	277.6	43.29	46.74	14.417	15.564
T3	223.3	247.6	36.63	41.03	12.196	13.663
T4	237.6	235.0	39.22	38.15	13.059	12.703
T5	223.3	266.3	35.29	44.92	11.750	14.959
T6	260.0	276.0	43.07	46.46	14.344	15.47
T7	297.3	298.6	52.63	54.96	17.525	18.300
T8	234.0	231.0	39.00	35.57	12.987	11.846
T9	231.3	253.3	36.09	40.20	12.017	13.385
T10	231.0	219.3	32.88	34.80	10.948	11.589
New LSD at 5% level	5.47	4.15	1.80	1.72	0.547	0.774

3. Fruit physical characteristics

3.1. Fruit height, diameter and fruit shape

The effect of foliar application treatments on fruit physical properties expressed as fruit height, diameter and fruit shape of Anna apple fruits during 2012 and 2013 seasons are presented in Table 4.

Fruit height and fruit diameter had affected by different treatments, while fruit shape not affected by these treatments in both seasons.

As for fruit height, it's clear from obtained data that T7 (fulvic acid with studied micronutrients after fruit set stage gave the highest significant values. While, data for fruit diameter showed the superiority of T3 (humic acid

with studied micronutrients at the beginning of false coloring) comparing to other treatments.

Table (4): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on both fruit height , diameter and shape index of apple trees during 2012 and 2013 seasons

Characters / Treatments	Fruit height (cm)		Fruit diameter (cm)		Fruit shape	
	2012 season	2013 season	2012 season	2013 season	2012 season	2013 season
T1	7.71	7.45	7.15	6.70	1.07	1.11
T2	7.84	7.62	6.96	7.09	1.12	1.07
T3	7.81	7.79	7.27	7.34	1.07	1.06
T4	7.97	7.44	6.96	7.07	1.14	1.05
T5	7.78	7.52	7.05	7.00	1.10	1.07
T6	7.77	7.66	7.03	6.91	1.10	1.10
T7	8.13	7.97	7.15	6.77	1.13	1.17
T8	7.65	7.66	7.04	7.15	1.08	1.07
T9	7.12	7.98	6.54	7.21	1.09	1.11
T10	7.16	7.80	6.73	7.10	1.06	1.09
New LSD at 5% level	0.07	0.24	0.08	0.11	0.01	0.04

3.2. Fruit weight and fruit volume.

Data given in Table 5 indicated interaction effect of foliar application treatments on fruit weight and fruit volume of Anna apple fruits in 2012 and 2013 seasons.

Data indicated that foliar application treatments had clearly effect on fruit weight and fruit volume in both seasons.

Regarding, both fruit weight and volume data indicate that, sprayed apple trees with T7 (the trees sprayed with fulvic acid and mixture of calcium nitrate (0.4 %), zinc sulphate (250 ppm) and borax (20ppm) after fruit set) gave significant results on fruit weight (177.0 - 184.0 g) and fruit volume (166.3 and 175.3 cm^3) in the first and second seasons, respectively.

It could be concluded that, sprayed apple trees with T7 gave clear significant results for fruit weight and fruit volume of Anna apple trees in 2012 and 2013 seasons.

These results are in agreement with those reported by Baolin *et al.* (2000) on apple trees , Somaa (2007) on apple , El-Kosary *et al*. (2011) on mango fruits , Fathy *et al.* (2010) on' apricot trees, Ferrara and Brunetti (2010) on table grape, Elatar (2012) on date palm and Hagagg *et al*. (2013) on olive trees. They found that the highest average fruit size (volume), weight, shape index (length\ diameter) were recorded from trees that sprayed with humic or fulvic acids.

Chen *et al*. (2004) explained the effect of humic substances as the increase in fruit weight and fruit dimensions as a consequence of HA-S application after fruit set is probably ascribed to the uptake of mineral

nutrients by the grapevines, but the possible hormone like activity of the HA-S (*i.e.,* auxin-, gibberellin- and cytokinin-like activity).

The increase in fruit weight and volume due to foliar application of micronutrients might be due to increase in cell size and intercellular space (Baker and Davis, 1951). Zinc has been identified as component of almost 60 enzymes and it has a role in synthesis of growth promoter hormone (auxin). Which is directly associated with improvement of Fresh weight of fruits (Shivanandam *et al.,* 2007). A favorable effect of foliar application of boron might be due to its role in cell division, cell elongation, sugar metabolism and accumulation of carbohydrates (Sourour, 2000). Also the combination of all the applied micronutrients increased the number of fruits per tree and yield of the tree might be due to the beneficial roles of boron in pollination (Lee and Kim, 1991).

In this concern, Yadav *et al.* (2013) and Ali *et al.* (2014) on peach, Asaad (2014) on Anna" apple and El-Shewy and Abdel-Khalek (2014) on "FloridaPrince and Desert Red" peach. They indicated that sprayed trees with microelements gave the highest values of fruit length, fruit diameter, fruit weight and fruit volume.

Table(5): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on both fruit weight and volume of apple trees during 2012 and 2013 seasons.

Characters / Treatments	Fruit weight (g)		Fruit volume (cm^3)	
	2012 season	2013 Season	2012 season	2013 Season
T1	166.6	162.3	148.0	151.3
T2	170.6	168.3	159.6	158.6
T3	164.0	165.6	140.0	148.0
T4	165.0	162.3	148.6	150.0
T5	158.0	168.6	137.3	158.6
T6	165.6	168.3	151.0	159.3
T7	177.0	184.0	166.3	175.3
T8	166.6	154.0	146.6	142.0
T9	156.0	158.6	135.3	143.3
T10	142.3	158.6	126.6	147.3
New LSD at 5% level	5.47	4.37	3.83	1.80

4. Fruit chemical properties

4.1. Soluble solids contents (SSC %), acidity (%), and SSC/ acid ratio

Presented data in Table 6 showed the effect of different treatments of foliar application treatments at different development stages on, SSC (%), acidity (%) and SSC/acid ratio of Anna Apple fruits in 2012 and 2013 seasons.

As for SSC %, data in Table 6 indicated that, T7 (the trees sprayed with fulvic acid and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) after complete fruit set) being the superior treatment for increasing SSC (15.66 and 15.23 %), followed by T5 (humic

acid and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) at the beginning of true coloring (15.00 and 15.13 %) in 2012 and 2013 seasons, respectively.

Also, same treatments (T7 and T5) achieved significant decrease on acidity % in Apple fruits in the two seasons in the study, where recorded (0.59, 0.61%) and (0.55, 0.66%).While, the highest significant decrease was with T6 which recorded 0.52 and 0.51 in the first and second seasons, respectively.

As for SSC%/ acid ratio, it's clear from the results that T5 (humic acid and micronutrients mixture at beginning of true coloring gave the highest significant values followed by T7 and T6.

These results are in line with those obtained by Ferrara and Brunetti (2010), who found that, on table grape humic acid applied at full-bloom induced a significant improvement of the beery quality parameters (titratable acidity and TSS / titratable acidity) and Elattar (2012) showed that on date palm, the highest values of SSC/ acid ratio contents in fruits were obtained by palm trees when treated by with 83.33 ml/palm fulvic acid at plus the mixture of 3.12 gm $FeSO_4.7H_2o$ +1.56 gm of $ZnSO_4.7H_2o$ +1.56 gm $MnSO_4.H_2o$ and 83.33 ml/palm micro-organisms. Also, Abbas *et al*. (2013) showed that maximum increment of 17.84% of TSS was found in fruits receiving 20 ml HA at three developmental stages of Kinnow mandarin.

Regarding, microelements effect, Khalifa *et al*.(2009) found TSS increased with boric acid at 0.05 % and 0.4 % calcium chloride, acidity increased with boric acid at 0.025 % and 0.1 % calcium chloride and Asgharzade and Babaeian (2012) showed that on apple use of micronutrient and calcium borate in foliar application method had significant effect total soluble solids, but maximum amount of fruit acidity was obtained in control treatment.

Table (6): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on some fruit chemical properties in apple trees during 2012 and 2013 seasons.

Characters / Treatments	SSC (%)		Acidity (%)		SSc/ acid ratio	
	2012 season	2013 season	2012 season	2013 season	2012 Season	2013 season
T1	13.83	14.23	0.64	0.65	21.73	21.91
T2	14.33	12.50	0.66	0.58	21.66	21.57
T3	13.00	13.20	0.61	0.62	21.59	21.31
T4	13.33	13.96	0.62	0.65	21.67	21.46
T5	15.00	15.13	0.55	0.66	27.37	26.80
T6	12.73	13.16	0.52	0.51	24.33	26.81
T7	15.66	15.23	0.59	0.61	26.53	25.01
T8	13.63	13.63	0.63	0.63	21.53	21.68
T9	12.66	12.93	0.65	0.62	19.38	20.71
T10	13.66	12.63	0.61	0.60	22.63	21.11
New LSD at 5% level	0.72	0.54	0.02	0.05	1.47	2.28

4.2. Fruit firmness and total sugars

Data in table 7 illustrated that, fruit firmness and total sugars of Apple fruit had affected by different foliar application of humic and fulvic with some tested nutrient elements at different development stages in both seasons of study.

Concerning, Fruit firmness, the trees sprayed with humic acid at 4 liter/fad. and mixture of calcium nitrate (0.4 %), zinc sulphate (250 ppm) and borax (20 ppm) at beginning of true coloring and the end of false coloring on Apple fruits (T5 and T4) gave a significant increase of fruit firmness (15.26-15.46) and (14.66-15.06) in the first and second seasons respectively, as compared to other tested treatments.

As for, total sugars, data showed that, T_7 (fulvic acid and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) after complete fruit set) gave a significant content values in that respect (10.20-10.92%), followed by T2 (humic acid and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm) after complete fruit set) (10.08-10.66%) in 2012 and 2013 seasons, respectively.

Table (7): Interaction effect of humic and fulvic acids with some nutrients as foliar spray at different time of applications on firmness lb/in^2 and total sugars % in fruit of apple trees during 2012 and 2013 seasons.

Treatments	Firmness (lb/in^2)		Total sugars (%)	
	2012 season	2013 Season	2012 season	2013 season
T1	12.30	13.43	9.78	9.25
T2	13.23	14.00	10.08	10.66
T3	12.93	12.60	9.17	10.16
T4	14.66	15.06	8.23	8.95
T5	15.26	15.46	8.45	10.23
T6	13.73	13.70	10.05	10.28
T7	12.60	13.36	10.20	10.92
T8	13.73	13.66	9.60	9.95
T9	12.30	12.46	9.21	9.23
T10	12.63	14.63	9.14	9.10
Ne-w LSD at 5% level	1.25	0.78	0.59	0.52

Generally, the significant values of total sugars were obtained with the trees sprayed with humic or fulvic acid at 4 liter/fad. combined with the mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm)at the early stages during the grown period of Apple fruits.

The increase in sugars in response to humic acid might be due to formation of maximum amount of different forms of carbohydrates within the leaf and fruit tissues of grapevine, which are then converted to the specific sugars like glucose and sucrose (Zachariakis *et al*., 2001).

Also,the stimulatory effects of HA have been directly correlated with enhanced uptake of P and K, which in turn, enhance the transport of photosynthate such as starch, sugar and organic acid from source to sink, (Mikkelsen,2005).

It cloud be concluded that at the same conditions of this work, sprayed apple trees with humic or fulvic acids at the rate of 4 liter/fed. and mixture of calcium nitrate (0.4 %) , zinc sulphate (250 ppm) and borax (20ppm)at the early stages during the grown period of Apple fruits were the best for enhancing yield and best quality of apple fruits.

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تـأثير حمـض الـهيومـك والفولفيـك وبعض المغذيات ومواعيـدالرش المختلفـة علـى المحصول وجودة الثمار فى أشجار التفاح الأنا

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اجريت هذه الدراسة خلال الموسمين المتعاقبين ٢٠١٢-٢٠١٣ على أشجار التفاح عمر ١٢ سنة والمطعومة على أصل شبرا خان وذلك فى مزرعة ذات تربة طينية فى طنطا محافظة الغربية على مسافات زراعة ٣×٤ . الأشجار مرباه بالطريقة الكأسية المفتوحة وتروى غمرا بمياة النيل وقد تم معاملة الأشجار تحت الدراسة بنفس المعاملات السمادية والبستانية .وقداشتملت هذه التجربة على 60 شجرة حيث عبارة عن 10 معاملة ، وقد أحتوت كل معاملة على ثلاث مكررات وكل مكررة أحتوت على شجرتين تحت نظام التجربة العاملية.

تم رش الأشجار بمخلوط من حمض الهيوميك أو حمض الفولفيك عند مستوى ٤ لتر / الفدان مع بعض المغذيات وهى نترات الكالسيوم بتركيز (٠,٤ %) وسلفات زنك بتركيز (٢٥٠ جزء فى المليون) وبوراكس بتركيز (٢٠ جزء فى المليون) خلال خمس مراحل مختلفة وهى (عند إنتفاخ البراعم – بعد العقد – عند بداية التلوين الكاذب – عند نهاية التلوين الكاذب – وعند بداية التلوين الحقيقى) .

أدت رش الأشجار بحمض الفولفيك عند مستوى ٤ لتر/الفدان مخلوط مع نترات الكالسيوم بتركيز (٠,٤ %) وسلفات زنك بتركيز (٢٥٠ جزء فى المليون) وبوراكس بتركيز (٢٠ جزء فى المليون) عند إنتفاخ البراعم (المعاملة السادسة) إلى زيادة معنوية لكلا من المساحة الورقية وطول النموات الحديثة خلال موسمى الدراسة , بينما المعاملة الثامنة والتى تمثلت فى رش الأشجار بمخلوط من حمض الفولفيك عند مستوى ٤ لتر/ الفدان مع نترات الكالسيوم بتركيز (٠,٤ %) وسلفات زنك بتركيز (٢٥٠ جزء فى المليون) وبوراكس بتركيز (٢٠ جزء فى المليون) عند تمام العقد قد سجلت أعلى القيم بالنسبة لعدد الثمار / الشجرة ووزن الثمرة ، كذلك حجم الثمرة ، المحتوى من المواد الصلبة الذائبة ، كذلك النسبة بين المحتوى من المواد الصلبة الذائبة إلى الحموضة كذلك المحتوى من السكريات الكلية , وقد أدت نفس المعاملة إلى نقص الكثافة النوعية للثمار خلال الموسمين .

سجلت المعاملة بحمض الهيوميك عند مستوى ٤ لتر/الفدان مع نترات الكالسيوم بتركيز (٠,٤ %) وسلفات زنك بتركيز (٢٥٠ جزء فى المليون) وبوراكس بتركيز (٢٠ جزء فى المليون) عند بداية التلوين الكاذب(المعاملة الثالثة) إلى زيادة ارتفاع وقطر الثمره خلال موسمى الدراسة . وقد ادت المعاملة بحمض الهيوميك عند مستوى ٤ لتر/الفدان مع نترات الكالسيوم بتركيز (٠,٤ %) وسلفات زنك بتركيز (٢٥٠ جزء فى المليون) وبوراكس بتركيز (٢٠ جزء فى المليون) عند نهاية التلوين الكاذب وبداية التلوين الحقيقى (المعاملة الرابعة والخامسة) إلى زيادة صلابة الثمرة مقارنة بباقى المعاملات تحت الدراسة خلال الموسمين .